Name: _____ Date: _____ Period: _____

Must-Knows: Unit 8 (Cell Division)

Ms. OK, AP Biology, 2014-2015

Test Format: 32 multiple choice questions (3 of these are "Science Skills" questions), 1 short response question

Topic #1: The Cell Cycle and Mitosis

1. What events take place in the cell during interphase?

Normal cell activities (ex: synthesis of ATP by mitochondria, synthesis of proteins by ribosomes) during the G1 phase, replication of DNA during the S phase, replication of organelles used during cell division (i.e. centrosomes) during the G2 phase

2. How does the amount of DNA in the cell change during the S stage of interphase?

The amount of DNA doubles during the S stage of interphase because the cell makes a full copy of its DNA.

3. How does the length of interphase change when the rate of cell division increases? How does the length of interphase change when the rate of cell division decreases?

The length of interphase decreases when the rate of cell division increases. The length of interphase increases when the rate of cell division decreases.

4. What is the G0 stage? Why might a cell enter the G0 stage?

Cells that have exited the cell cycle and will no longer divide. Cells might enter the G0 stage if they are needed for normal activities but not needed to produce replacement cells.

5. Describe the organization of DNA in a prokaryotic cell.

DNA is organized as a single circular chromosome in a prokaryotic cell with small circles of extrachromosomal (outside the chromosome) DNA called plasmids.

6. Describe the organization of DNA in a eukaryotic cell. Why do chromosomes in cells preparing for mitosis have two identical chromatids?

When a eukaryotic cell is not preparing for division or actively dividing, its DNA is organized as a loose assortment of DNA and histone proteins. This loose assortment is called chromatin. Chromatin super-coils into X-shaped (aka linear) chromosomes during prophase of mitosis. Chromosomes have two identical chromatids because these chromatids split during anaphase of mitosis and one chromatid goes to each daughter cell, to give each daughter cell a full copy of DNA.

7. How is prokaryotic binary fission different from eukaryotic mitosis?

Binary fission involves the copying of the prokaryotic cell's single circular chromosome and the division of chromosome copies as well as the cytoplasm when the cell membrane pinches in. If the prokaryotic cell has a cell wall, a new cell wall will be built between the daughter cells.

Eukaryotic mitosis involves the division of much more DNA. Therefore, DNA must coil into X-shaped chromosomes so that it is easier to divide during anaphase of mitosis.

8. In what stage of mitosis does the mitotic spindle form? In what stage does it break down?

The mitotic spindle forms during prophase and breaks down during telophase.

9. Why is cytokinesis necessary after mitosis? If mitosis but not cytokinesis occurred in onion root tip cells, what would you expect to see on a slide of these root cells?

Cytokinesis divides the cytoplasm after mitosis divides the nucleus and DNA. If mitosis but not cytokinesis occurs, onion cells will be very large and have several nuclei because the cytoplasm failed to divide after division of the nucleus.

10. Why do scientists believe that centrosomes and not centrioles are responsible for mitotic spindle formation?

Centrosomes are found in both animal and plant cells, both of which can create mitotic spindles. Only animal cells have centrioles. Since mitotic spindles can form in plant cells (which do not have centrioles), scientists believe that centrosomes—not centrioles—are responsible for mitotic spindle formation.

11. How is cytokinesis different in animal vs. plant cells?

In animal cells, the cell membrane pinches in to form a cleavage furrow that separates the two daughter cells. In plant cells, vesicles from the Golgi apparatus deposit materials necessary to build a cell wall between the two daughter nuclei. This new cell wall that forms between the daughter cells is called a cell plate.

12. What are the purposes of mitosis in multicellular organisms?

In multicellular organisms, mitosis is used for growth/development, replacement of cells lost due to normal wear and tear, and replacement of cells lost due to injury. A few multicellular organisms can use mitosis to create a clone of themselves as a form of asexual reproduction (ex: grafting in plants and budding in hydra).

13. What is the difference between diploid (2n) and haploid (n) cells? Does mitosis create diploid or haploid daughter cells from a parent diploid cell?

A diploid cell has two sets of chromosomes (for a total of 46 chromosomes in human diploid cells). A haploid cell has one set of chromosomes (for a total of 23 chromosomes in human haploid cells). Mitosis creates two diploid daughter cells from a parent diploid cell.

14. What happens during anaphase?

During anaphase, spindle fibers shorten, causing chromatids to be ripped apart at the centromere. Once ripped apart, these chromatids are now considered daughter chromosomes, which travel to opposite ends (poles) of the dividing cell.

Topic #2: Meiosis

15. How many daughter cells are created in meiosis? What types of cells (diploid or haploid) are these daughter cells?

Four haploid daughter cells are created during meiosis.

16. When do synapsis and crossing over occur during meiosis? What is the purpose of this process?

Synapsis (the pairing of homologous chromosomes) and crossing over (the exchange of genetic material between homologous chromosomes) occur during prophase I of meiosis. The purpose of this process is to create eggs or sperm that are genetically different from one another to increase genetic variation in the population.

17. Describe the differences between metaphase I and metaphase II of meiosis. See the images posted to the Wiki page for a visual.

In metaphase I, homologous chromosomes line up in pairs along the metaphase plate. In metaphase II, chromosomes line up single file along the metaphase plate.

18. Describe the differences between anaphase I and anaphase II of meiosis. See the images posted to the Wiki page for a visual.

During anaphase I, pairs of homologous chromosomes separate and move to opposite ends of the dividing cell. This will create haploid daughter cells with daughter chromosomes containing two chromatids (still X-shaped). During anaphase II, chromatids are ripped apart at the centromere and move to opposite ends of the dividing cell. This will create haploid daughter cells with daughter chromosomes containing one chromatid.

19. How does the amount of DNA in a diploid cell that has just copied its DNA in preparation for meiosis compare to the amount of DNA in a haploid daughter cell at the end of meiosis II?

A haploid daughter cell has ½ the number of chromosomes of the diploid parent cell and ¼ the amount of DNA. (The ¼ comes from having half the chromosomes, each with only one chromatid.)

20. Why must gametes (eggs and sperm) be haploid cells?

Eggs and sperm must be haploid so that they can join together during fertilization and create a fertilized egg (aka zygote) that is diploid. This diploid zygote will then divide many times by mitosis to create a multicellular embryo with all diploid body cells.

21. How does meiosis increase genetic variation in a population? (Hint: there are three ways!!!)

Meiosis increases genetic variation in a population by crossing over between homologous chromosomes, independent assortment of homologous chromosome pairs along the metaphase plate, and random fertilization. Technically, random fertilization occurs AFTER meiosis has created many unique egg or sperm cells, so you can definitely argue that it is NOT one of the ways that MEIOSIS increases genetic variation in a population.

22. Why do populations of organisms that use meiosis and sexual reproduction have an evolutionary advantage over populations of organisms that use asexual reproduction?

If organisms use asexual reproduction, they are all genetically identical (except for any differences due to mutation) and therefore genetically vulnerable to the same diseases, environmental stresses, etc. Thus, the population is at risk for extinction if a particular disease to which they are all susceptible affects the population. If organisms use sexual reproduction, they are genetically different from one another. As such, there will typically be members of the population that are genetically resistant to certain diseases, environmental stresses, etc. Thus, a population that reproduces by sexual reproduction will be less at risk for extinction.

Topic #3: Cell Cycle Regulation

23. How are cancer cells different from normal cells?

Cancer cells do not show density-dependent inhibition or anchorage dependency. Their cell cycles are unregulated, and they typically show much higher rates of cell division than normal cells.

24. What is the difference between a benign and a malignant tumor?

A benign tumor remains in the original location. A malignant tumor has cells that break off and can spread through the blood or lymph vessels via metastasis to create new tumors in other locations in the body.

25. What occurs at the M phase checkpoint?

At the M phase checkpoint, the cell checks to make sure all chromosomes are properly attached to spindle fibers before anaphase can occur.

26. Why do most cancer treatments target rapidly dividing cells?

Cancer cells divide quickly, so it would make sense for cancer treatments to target and kill cells that divide quickly.

******Note: On your test, there will be three "Science Skills" multiple choice questions. Though the questions are related to cell division data, you really only need to use critical thinking skills to find the answers.******